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FLORISTICS OF A SANDSTONE GLADE IN WESTERN LOUISIANA

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ABSTRACT

The floristics, species richness, geology, and edaphic conditions of a western Louisiana sandstone glade are described.

KEY WORDS: Sandstone glade, Kisatchie National Forest, floristics, Louisiana

INTRODUCTION

The eastern United States is basically a forested region. Within this region, there are occasional permanent forest openings — bogs, savannahs, glades, barrens, balds, prairies— often of small size (*e.g.*, Greller 1988; DeSelm 1986, 1990). These openings are almost always the result of unusual edaphic, geologic, and hydrologic factors.

Sandstone glades are one such open community in the longleaf pine region of western Louisiana. As Martin & Smith (1991) have described them, these are usually ridge tops underlain by Catahoula sandstone with a thin layer of acidic silty clay loam. Glades are open with exposed sandstone boulders and ledges. There is no true overstory or midstory but scattered patches of trees and shrubs with a grass dominated, low diversity herbaceous layer. Ever since the Louisiana Natural Heritage Program began rating communities, this one has received rankings from critically imperiled to rare or uncommon (Craig *et al.* 1987; Smith 1988; Martin & Smith 1991). Within Louisiana, the community is restricted to a small part of the western section of the state and little is known about it; in fact, the entire previous literature on this and related communities in the western gulf coastal plain can be found in Smith 1988; Bridges & Orzell 1989; Orzell 1990; Martin *et al.* 1990, and Martin & Smith 1991. Sandstone glades of the type we are describing here are not to be confused with calcareous prairies or other prairielike communities, often

referred to as barrens, glades, or prairies, occurring in this area (Bridges & Orzell 1989; Marietta & Nixon 1984; Smith *et al.* 1989; George & Nixon 1990).

The purpose of this paper is to describe the floristics and species richness (number of species) of one glade. Additionally, we will make some observations on biotic, edaphic, and climatic conditions of glades.

STUDY SITE AND METHODS

Sandstone glades are locally common in the Kisatchie Ranger District of the Kisatchie National Forest, Natchitoches Parish, Louisiana. "Flat Glade," the one we studied, is located about 11 km WSW of Cloutierville, Louisiana, on the eastern edge of T6N R7W S12. Its exact location is given by Martin & Smith (1991:288-291). It is approximately 100 meters above sea level. While the specific fire history of Flat Glade is uncertain, it is embedded in the pyrogenic longleaf pine community and thus probably has burned with regularity in the past (Smith 1991). It did not burn the year prior to this study.

We visited Flat Glade every two weeks between March and December 1991 to sample vascular plants. We follow MacRoberts (1984, 1989) for botanical nomenclature. We measured species richness in three randomly selected permanent one meter square plots, pine seedling success (number of seedlings surviving to November) in two permanent four meter square plots, and pine seedling numbers in ten randomly selected nonpermanent one meter square plots. We ran a transect through Flat Glade in which we counted number of trees and measured diameter at breast height (dbh) of each tree. The transect was 213 meters long and three meters wide, and ran through the longest part of the glade. Soil samples were taken from the upper 15 cm of the glade and were analyzed by A. & L. Agricultural Laboratories, Memphis, Tennessee. We made increment borings of "relic" (predate the massive cutover of the early 1900's) longleaf pine trees to assess age and counted rings in a number of smaller trees. We looked at many other glades in the area to familiarize ourselves with variations in the community type.

RESULTS

A profile of Flat Glade is shown in Figure 1. The glade measures about 1.9 hectares and is larger than most glades in the area. It is a mesalike outcrop rising in two tiers of about seven meters each above the surrounding upland longleaf pine forest. The transition from glade to longleaf forest is not usually abrupt. Pines are scattered over Flat Glade and are stunted and dwarfed. The largest are not over twelve meters tall, are flat topped, and have sparse crowns. Canopy cover is about ten percent overall. A few oaks occur in Flat Glade.

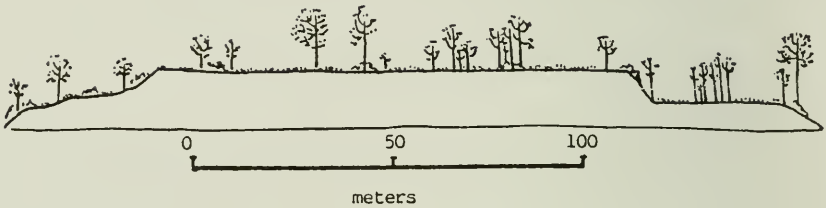

Figure 1. Profile of Flat Glade

These are also stunted, gnarled, and scarcely rise above the few shrubs, *Ilex vomitoria* Ait. and *Vaccinium* spp.

There were 25 trees 1.5 meters tall or taller in the 639 square meter transect: 15 longleaf pine, 9 loblolly pine, and one oak. This translates into one tree per 26 square meters. These trees had a mean dbh of 11.32 cm (range 2.4-38.0 cm, s.d. 9.1 cm). In these measurements of trees, Flat Glade lies between hillside seepage bogs and longleaf pine forest in the area. Hillside seepage bogs have a more open habitat while longleaf pine forest is much less open (MacRoberts & MacRoberts 1990).

Why are glades open? Possible answers are poor seed production, poor seed germination, high seed predation, or high seedling mortality. While we have been studying this and will report on it more fully elsewhere, some data collected at Flat Glade are germane to this paper. To begin with, all pine species occurring on Flat Glade produce abundant cones. This is evident from the cones seen on trees and those on the ground from previous years. Also seeds readily sprout. On July 6, 1991 in ten one meter square plots randomly selected on the top of Flat Glade, we found two longleaf pine and nineteen loblolly pine seedlings. From these observations and from our general survey of the glade, there were undoubtedly thousands of seedlings on the 1.9 ha area. In the two four meter square plots described above, we counted 26 and 27 loblolly pine seedlings in May. By November there were ten alive in one plot and none in the other. All of the dead seedlings appeared to have succumbed to dessication and to scorching as they were without shade. And this occurred even though it was one of the wettest years in recorded history but by no means the hottest (pers. comm., National Weather Service). The seedlings that were still alive showed some signs of stress (brown lower needles). In many of the glades we visited, we noticed that trees had fallen, exposing shallow roots. The causes for this appeared to be shallow depth of the impermeable sandstone layer resulting in shallow rooting and susceptibility to windthrow.

In order to examine growth rate, we cut four small longleaf pines (diameter 4.5-7.0 cm at ground level) and made increment borings in some of the largest longleaf pines present (dbh 29-38 cm) and compared these with trees from the surrounding longleaf pine habitat. We found that longleaf pines grow slowly in Flat Glade. In the four small trees, average ring width was slightly less than 1 mm (11 rings to 1 cm), and in the larger trees it was comparable but an average was harder to determine because the rings were sometimes so packed that counting was difficult. Nonetheless, the growth rate of trees in Flat Glade was about one-third that of trees in local longleaf pine forest. All of the large trees at Flat Glade appear to be "old growth" being easily in excess of one hundred years and probably much older.

Soil information on Flat Glade is given in Table 1. Three samples were taken: two from the top and one from the middle mesa. The soil is highly acidic and essentially infertile. The surface geology is resistant beds of Catahoula

TABLE 1. Soil Characteristics

	Exchangeable Ions (ppm)					
Sample	pH	P	K	Ca	Mg	OM%
K-1	4.9	4	65	900	260	0.3
K-2	4.8	4	44	53	135	1.9
K-3	4.5	5	127	730	233	4.0

sandstone overlain with Kisatchie soil — dark to light grey silty loam (fine montmorillonitic, thermic Typic Hapludalfs) (Martin *et al.* 1990:104). Part of Flat Glade is severely eroded, forming irregular sandstone studded gullies and minigorges of exposed soil. Although the soil is always thin and shallow, on the stable areas prairielike vegetation dominates, while on the more sparse and rocky areas where the soil is either very thin or absent, lichens and mosses are commonly the major ground cover. Plant roots are limited by the rock below.

The soil moisture conditions of glades range from saturated and sticky after rains especially during winter and spring, to dry cracked and hard during summer and fall following droughts. Water runoff is fairly rapid. The year of this study, 1991, was one of the wettest in recorded history with about 170 cm of precipitation (43 cm above normal) (pers. comm., Natchitoches Station, National Weather Service), and only occasionally did Flat Glade dry out. In most years it would have been dry for periods of at least two to three weeks and possibly longer during the hottest months, July, August, and September. In July and August soil surface temperatures become very high, there being little or no shade. Additional climatic data for the area are given in Martin *et al.* 1990.

The vascular plants found in Flat Glade are listed in Table 2. We recorded 63 taxa representing 46 genera and 26 families. The dominant species were rayless goldenrod (*Bigelowia nuttallii* Anderson) and little bluestem (*Schizachyrium scoparium* [Michx.] Nash). The dominant families were grasses and composites, accounting for a third of the taxa. The three one meter plots had 9, 9, and 11 species, which is about half the richness of comparable plots in local hillside seepage bogs (MacRoberts & MacRoberts 1991). Herbaceous plant ground cover was not always 100 percent, with many bare areas of rock or soil often with numerous lichens and mosses.

Flat Glade, like other glades we have observed, clearly has plants associated with other communities, notably upland longleaf pine forest and sand woodlands (Martin & Smith 1991). These communities tend to be dry. Quite spectacularly, about ten percent of the species characterize hillside seepage bogs: *Aletris*, *Drosera*, *Pinguicula*, *Platanthera*, *Sabatia gentianoides*, and *Asclepias longifolia* Michx. (MacRoberts & MacRoberts 1991). In the glades, these plants take advantage of the open, seasonally saturated soils caused by

underlying sandstone "catchments" and ephemeral seepage areas. *Pinguicula* is notorious in bogs for blooming for about nine months a year. In Flat Glade, *Pinguicula* bloomed in late spring and early summer and again in December.

As mentioned in the introduction, glades are quite variable from one to another. During the course of the year we visited many glades which ranged from prairielike with many grasses to bare sandstone outcrops almost totally devoid of vegetation. Interesting species not found at Flat Glade but common at other glades include: *Eryngium yuccifolium* Michx., *Fimbristylis puberula* (Michx.) Vahl., *Hedyotis nigricans* (Lam.) Fosberg, *Lechea tenuifolia* Michx., *Selaginella arenicola* Underw. ssp. *riddellii* (Van Eselt.) Tryon, *Silphium laciniatum* L., and *Talinum parviflorum* Nutt. *ex* Torrey & Gray.

DISCUSSION/SUMMARY

A major factor controlling plant community structure and composition of glades is stress. The thin, nutrient poor acidic loam soils underlain by impermeable sandstone characterized by high erosion, quick alternation of wet and very dry periods, occasional burning, and high summer temperatures, combine to produce a unique community — dwarfed and sparse, slow growing woody vegetation and hydric, mesic, and xeric herbaceous plants in relatively low numbers with large expanses of bare, or lichen or moss covered ground. While we have carefully investigated only one example of a glade community, we have looked at many of them and recognize that these communities differ in many ways undoubtedly depending on variations in soil, hydrology, and geology. Some have no hydric plants; others have many. Some have no trees because of a lack of soil, while others have many. Clearly, therefore, the habitat needs further investigation.

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Table 2. Taxa present in Flat Glade.

AMARYLLIDACEAE — *Hypoxis rigida* Chapm.
CYPERACEAE — *Rhynchospora globularis* (Chapm.) Small, *R. plumosa* Ell., *Scleria ciliata* Michx.
JUNCACEAE — *Juncus marginatus* Rostk.
LILIACEAE — *Aletris aurea* Walt., *A. farinosa* L., *Allium canadense* L.
ORCHIDACEAE — *Platanthera nivea* (Nutt.) Luer, *Spiranthes tuberosa* Raf., *S. vernalis* Engelm. & Gray.
PINACEAE — *Pinus echinata* P. Mill., *P. palustris* P. Mill., *P. taeda* L.
POACEAE — *Andropogon elliottii* Chapm., *A. ternarius* Michx., *Anthaenantia villosa* (Michx.) Beauv., *Aristida virgata* Trin., *Dichanthelium aciculare* (Desv. *ex* Poir.) Gould & Clark, *D. sphaerocarpon* (Ell.) Gould, *Schizachyrium scoparium* (Michx.) Nash, *Schizachyrium tenerum* Nees, *Sporobolus junceus* (Michx.) Kunth.
ASCLEPIADACEAE — *Asclepias longifolia* Michx., *A. obovata* Ell.
ASTERACEAE — *Aster dumosus* L., *A. linariifolius* L., *Bigelowia nuttallii* Anderson, *Eupatorium leucolepis* (DC.) Torrey & Gray, *Helianthus angustifolius* L., *Heleastrum hemisphericum* (Alex.) Shinners, *Heterotheca graminifolia* (Michx.) Shinners, *Liatris pycnostachya* Michx., *L. squarrosa* (L.) Michx., *Senecio tomentosus* Michx., *Solidago nitida* Torrey & Gray, *Vernonia texana* (A. Gray) Small.
AQUIFOLIACEAE — *Ilex vomitoria* Ait.
CAMPANULACEAE — *Lobelia* sp.
CLUSIACEAE — *Hypericum gentianoides* (L.) B.S.P., *H. hypericoides* (L.) Crantz.
DROSERACEAE — *Drosera brevifolia* Pursh.
ERICACEAE — *Vaccinium arboreum* Marsh, *V. corymbosum* L., *V. stamineum* L.
EUPHORBIACEAE — *Euphorbia corollata* L.
FABACEAE — *Stylosanthes biflora* (L.) B.S.P., *Tephrosia virginiana* (L.) Pers.
FAGACEAE — *Quercus falcata* Michx., *Q. marilandica* Muenchh., *Q. stellata* Wang.
GENTIANACEAE — *Sabatia gentianoides* Ell.
LENTIBULARIACEAE — *Pinguicula pumila* Michx.
LINACEAE — *Linum medium* (Planch.) Britt.
LOGANIACEAE — *Gelsemium sempervirens* (L.) St. Hill.
MYRICACEAE — *Myrica cerifera* L.
POLYGALACEAE — *Polygala mariana* P. Mill., *P. nana* (Michx.) DC.
RUBIACEAE — *Diodia teres* Walt.
SCROPHULARIACEAE — *Agalinus obtusifolia* Raf., *Aureolaria pectinata* (Nutt.) Penn., *Penstemon tubaeflorus* Nutt.
VIOLACEAE — *Viola pedata* L.

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